LANDCARE (MANCHESTER) LIMITED
STORMY WEST LANDFILL SITE, PYLE

Environmental Permit – EAWML34009

ENVIRONMENTAL MONITORING OF WATER QUALITY FOR 2015

MAY 2016

CONTRACT - LAN/SW/2/16

PLR SERVICES

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The interpretation referenced within this report is in part based upon information, knowledge and results made available from externally supplied sources at the time of the report issue. Full reliance is placed upon the accuracy of such and thus any responsibility for incorrect information supplied from these sources cannot be accepted.

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1. SUMMARY

This report has been prepared to present the environmental monitoring information compiled for the 2015 monitoring period. The site monitoring data is presented in comparison with appropriate standards for the assessment of water quality and in addition to the data compiled and reported upon in previous monitoring periods.

Therefore this report continues to follow the same format as that presented for previous annual reports and the presentation of data therein and includes:

a. information upon the site,
b. the data compiled,
c. tables of results,
d. comparisons versus respective standards/guidelines issued via EC Directives and UK guidance.

Thus the results obtained and comparisons made continue to indicate that there is currently a low probability that the Stormy West landfill site is or will cause any significant environmental impact due to any emissions and/or discharges.

On comparison with current guidance issued for the assessment of contaminated land e.g. landfill sites, no direct targets/receptors are known to be within the immediate area of this site with no additional/direct development in the vicinity since the previous report.

At the time of the preparation of this report it was not thought that any further external hydreogeological/hydrological assessments have been performed within the vicinity of the site since the last report. Notwithstanding this and reported previously some work has been done upon the potential impact of the deepening of quarrying activities within the Cornelly area however no further information has been made available on this investigation (Ref.1).

In addition and it is worthy of note and of which may be further observed there was a variation within the analytical results and limits due to a new test laboratory being assigned for the site analytical needs since 2014.

2. INTRODUCTION

At the request of the management of Landcare (Manchester) Limited, in response to the annual requirement of Natural Resources Wales (NRW), incorporated within the Environmental Permit, this report was prepared by PLR Services. This report was to offer an interpretation of the potential impact the Stormy West landfill site may have upon the hydrology and hydreogeology of the surrounding area.

Thus the monitoring data is presented as a summary of water quality in and around the site boundary, due to it being previously operated as a waste disposal facility and of which has now been restored and is still within the aftercare period.

The analytical results have been reported versus criteria and guidance issued within Waste Management Papers (these being the guidance available at that time the site was being operated and needed to be in compliance), EC directives/publications and UK guidance.

For groundwater the 1998 EC Directive on the Quality of Water Intended for Human Consumption (98/83/EC) which has implemented in England by the Water Supply (Water Quality) Regulations 2000 and in Wales by the Water Supply (Water Quality) Regulations 2001 (Ref.12).

Thus for this monitoring period water quality has been compared with that specified within the schedules of the above drinking water regulations.

The assigned limits for surface water and leachate monitoring results remain in conjunction with that used for previous monitoring periods.

The data collected during the 2015 monitoring period has been reproduced within tables within the appendices.

3. BACKGROUND INFORMATION

The Stormy West Landfill Site had been operated under the principle of dilute and disperse which has allowed the products of the biodegradation of the waste materials to be potentially neutralised by the assimilative capacity of the natural strata and hydreogeological pathways present within and beneath the site.

The site, prior to being landfilled, had been a disused limestone quarry (see Appendix A) and of which has been refilled with household, industrial, commercial and some Special Wastes as per the planning permission (Ref:2) and Waste Disposal Licence No. 5 (previously the WML) now an Environmental Permit (Ref.3) issued by the then Regulatory Authority, Ogwr Borough Council.

These waste types were disposed of/landfilled between 1985 and 1996 (after which the site closed) and during this period approximately one million cubic metres of void space was landfilled.

Over the life of the site a number of reports had been presented relating to the co-disposal activities and assessments of the impact upon groundwater quality (Ref. 4).

During the early part of the nineties appreciable concentrations of landfill gas were emitted resulting in active gas extraction utilizing active gaswells with extraction and management via a high temperature burner/flare.
In addition, and complimenting this, landfill gas was used for a few years at the mid to back end of the nineties to support combustion within a lime kiln utilisation scheme. Unfortunately this was needed to be stopped due to the problems experienced with the kiln end user and thus the site reverted back to flaring and of which continues to present day.

As the site has now been fully restored, via capping with low permeability clay, with the approval of the planning section of the local authority (Bridgend County Borough Council), ingress of precipitation will be significantly reduced and thus the potential for any adverse environmental impact should be minimal.

4. LEGISLATIVE OVERVIEW

The principle environmental legislation governing the operation and any subsequent environmental impact of facilities is that of the Environmental Protection Act 1990 (Ref.5) and regulations issued under it e.g. the Environmental Permit (EP).
In addition publications such as the NRW (ex. EA) guidance documents and previous DOE Waste Management Papers (WMP) as appropriate have been referenced to indicate practices at that time and the minimum monitoring requirements. Related documents also include European Union Directives (see references section). It is worthy of note that this site, due to the date of closure, does not fall under the Landfill Regulations (Ref.6)
As indicated above The 1998 EC Directive on the Quality of Water Intended for Human Consumption (98/83/EC) which has been implemented in England by the Water Supply (Water Quality) Regulations 2000 and in Wales by the Water Supply (Water Quality) Regulations 2001 have been used to for the test results comparison purposes.

5. GENERAL DESCRIPTION OF THE SITE

As indicated earlier it is not known whether any additional surveys have been performed since the report prepared from the 2014 data. Thus the most recent reference to hydreogeological surveys and groundwater studies (Ref.4) in this area has indicated that the predominant groundwater flow direction in the vicinity of the Stormy West site is north westwards, or westwards (see figure 1), although there was limited information which has suggested the flow could be reversed under certain circumstances.

This report also suggests that the probable discharge is believed to be the Bristol Channel, with flows passing at depth beneath Kenfig Pool and thus this is the reasoning behind monitoring at this location and a further monitoring point is located at the nearby Pyle Spring surface water sources (see Appendix B).

In addition, from information obtained from within the above report suggests that there is significant attenuation of leachate coupled with a high dilution probability of 500 fold within 400 metres and 1000 fold within 500 metres of the site thus implying limited, if any, impact upon the surrounding water environment.

At the time of the preparation of this report it is understood that there isn't any additional information known to defend or contradict this assessment.

6. MONITORING and SAMPLING DATA

In line with the requirements of NRW (previously the Environment Agency or EA) the data received from various monitoring points in and around the site generally comply with the guidance documents indicated earlier e.g. DOE WMP No.4 (Ref.7) and any additional determinands requested by NRW (Environment Agency, EA) and the previous regulators i.e. Ogwr Borough Council and/or the National Rivers Authority.

It is worthy of note that the testing protocol has been based, as with previous annual reports, upon the requirements within the then Waste Management Papers (WMP) and the results obtained for these determinands compared with the respective levels/limits published within the reference directives with the groundwater limits being referenced versus the Water Supply/Quality Standards, WQS (Ref.12) and not the EC directive per se as presented within previous annual reports.

The locations of the monitoring/sampling points used routinely to obtain samples are presented in Appendix C.

Thus the historical sampling and testing protocol as previously agreed and maintained by NRW (EA) may be presented below.

Table 1 **Determinands tested for water quality**

Acidity/alkalinity	pH	Conductivity	Cond.
Biological Oxygen Demand	BOD	Oxygen	O2
Chemical Oxygen Demand	COD	Total Organic Carbon	TOC
Ammoniacal Nitrogen	NH4	Total Organic Nitrogen	TON
Nitrate	NO3	Nitrite	NO2
Alkalinity	Alk	Chloride	Cl
Sulphate	SO4	Phosphate	PO4
Sodium	Na	Potassium	K
Copper	Cu	Magnesium	Mg
Calcium	Ca	Zinc	Zn
Cadmium	Cd	Lead	Pb
Chromium	Cr	Manganese	Mn
Iron	Fe	Nickel	Ni
Total Volatile Fatty Acids	VFA		

The frequency of analyses/testing protocol for the determinands continues as:
Leachate – monthly (partial analysis) and quarterly for full analysis at one location,
Groundwater – Quarterly analysis at three locations,
Surface water – Quarterly analysis at the Pyle location,
Surface water - Bi-annually analysis at the Kenfig Pool location.

6.1 Leachate samples

There is one leachate monitoring chamber present within the site with its location indicated upon the site plan (attached) although this point from experience has tended to be mostly dry due to dispersal/attenuation. Thus due to this an alternative sampling point has been approved and used in order to obtain a more representative sample of fluid/leachate at the base of the site i.e. gas well B5. Worthy of note is that on dipping this well the level of fluid present has remained relatively constant.

The analytical results are presented in Appendix D and on review of this data it may be observed that elevated results were recorded when compared with the Landfill Completion Criteria presented within WMP No: 26A (Ref.8 and presented within Appendix E).

Throughout the monitoring period (i.e. 2015) elevated results were again obtained for a limited number of determinands when compared to the overall suite of analyses performed. These results may also be compared to those obtained for the year 2014 and previous years as indicated upon the tabulated results found in the appendices to this report and thus any trends may be determined as indicated below.

Table 2	**Leachate results**				
Determinand.	**Spec. limits**	**2015**	**2014**	**2013**	**2012**
Conductivity	LT 4000	6967	7243	6200	5993
Ammonia (as N)	LT 5	316	510	415	362
Chloride	LT 2000	562	717	536	400
COD	No specified limit	557	777	751	686
TOC	LT 10	181*	237	107	78
Iron	LT 2	1	1	5	2
Potassium	LT 120	193	221	185	143

*One test result only

All results in PPM (mg/litre) except Conductivity (uS/cm) – (LT – Less Than)

A summation of the above information can be concluded by reference to a survey (Ref.9) published by the Environment Agency which has indicated that the three most frequently identified contaminants for a landfill leachate have been detailed as Ammonia, Chloride and Chemical Oxygen Demand (COD).

From the table of results it can be seen that this is indeed the case, although the chloride results fall well below the specified limit, on comparison to the relative standards used for assessment of water quality (see Appendix F).

It may be observed from the above that the results are in general similar to that determined for 2014, although lower from for those observed from previous annual reports, and as shown upon the table of results for Leachate within the appendices. Therefore it may be deduced that in general there is still a trend of an improvement in leachate quality over that indicated for the preceding years reported upon here. Nevertheless it is worthy of note that of these it may also be observed that a small number of outlying results are evident upon the tabulated result sheet as presented and may be observed within the appendices.

Previous annual reports had suggested that the possible reason for a reduction year on year may be attributed and explained as:

- the reduction in infiltration through the cap thus not allowing leaching of the residual waste still present,
- the residual waste moving toward the latter stages of waste bio-degradation of the landfill processes (Ref.8) (also evident in the lower concentrations of landfill gas being liberated/emitted).

6.2 Surface water

Two surface water monitoring/sampling points have been identified around the site.

Both these locations have been referred to within Section 3 and are: -

- Kenfig pool — an expanse of still water lying to the west of the landfill site with significant amenity usage.
- Pyle Spring — a small stream which lies north westerly, skirting the edge of the Pyle industrial/factory estate location down strata of the site.

(It is worthy of note that this water source could also be affected by industrial operations being performed upon this estate).

Results obtained from both these sources are generally in compliance with monitoring results determined from previous monitoring periods and within specified limits when compared to the guidance issued within the EC Directive for surface water (Ref.10).

6.3 Groundwater

There are three groundwater (g/w) monitoring/sampling points located around the site. The locations of these have been referred to within Section 3, and can be observed in Appendix C.

These are: -

- A48 — a borehole located adjacent to the **A48** dual carriageway and which lies to the south of the site, and bordering fields used for agriculture.
- GW2 — a borehole (b/h2) located within the site **car park** area and lies to the south west of the edge of the original quarry workings, but outside of the landfilled area.
- GW3 — a borehole (b/h3) located near the **site entrance** at the outer extremity of the overall site area but further south than GW2, which again lies south west of the original filled area.

In general on review of the results it may be observed that for some determinands elevated levels are present within all three boreholes/monitoring points by comparison with the guidance issued within the WQS (Ref.12) employed for this report (previously the EC Directive for groundwater was used, Ref. 11).

However for comparative purposes only those determinands used for previous reporting requirements have still been highlighted albeit they may not necessarily exceed the specified limits now assigned.

As reported previously it is also evident that in general the water rest levels in each borehole appear to be lower than observed in previous monitoring periods and as such any determinands could be more concentrated in that they are not being recharged and/or diluted as those results obtained in previous years.

This table presents the depth of the groundwater within the monitoring boreholes at the time of sampling and the indicative leachate level within the gas well.

Table 3 **Water Rest Levels**

Date.	A48 (AOD)	B/H 2 (AOD)	B/H3 (AOD)	Gas Well B5 (Leachate) (AOD)
19/03/15	12.0 (88.2)	12.0 (89.4)	10.6 (90.0)	14.9 (93.1)
19/06/15	19.0 (81.2)	16.5 (84.7)	19.9 (80.7)	13.6 (94.4)
15/09/15	15.2 (85.0)	11.4 (90.0)	24.3 (76.3)	14.6 (93.4)
14/12/15	10.3 (89.9)	11.3 (90.1)	14.6 (86.0)	14.2 (93.8)
Mean 2015	14.1 (86.1)	12.8 (88.6)	13.7 (86.9)	14.7 (93.3)
Mean 2014	15.4 (84.8)	15.1 (86.3)	18.8 (81.8)	14.5 (93.5)
Mean 2013	18.6 (81.6)	14.7 (86.7)	17.4 (83.2)	14.8 (93.2)
Mean 2012	12.8 (87.4)	12.6 (88.8)	13.4 (87.2)	14.8 (93.2)
Mean 2011	16.1 (84.1)	14.0 (87.4)	15.5 (85.1)	15.1 (92.9)
AOD level	**100.2**	**101.4**	**100.6**	**108**

The following table presents the average water quality results: -

Table 4 **Groundwater levels**

Determinand.	Spec. limits	A48	GW2	GW3
The determinands indicated below are those of which in this and/or previous monitoring reports have exceeded the specified limits assigned at that time:				
Ammon. Nit.	0.5	12.1	1.2#	0.4
Nitrite	0.5	12.3	0.8	4.3
Potassium	12	13#	5	5
Manganese	0.05	0.5#	0.04	0.24#
Iron	0.2	0.1	0.1	0.01
Lead	0.025	<0.0002	0.001	<0.025

* Indicates that only one result exceeds the specified limit for that monitoring period

includes a result which does not follow that expected/outlying (see table of results)

All results in PPM (mg/litre) except Conductivity (uS/cm) – Exceeds 2014 results.

Summation- from the table of results it may be observed that there are only a very limited number of determinand results exceeding the specified limits assigned. Excepting the above highlighted results the water quality may also be generally observed to show a slight improvement albeit with identifiable outlying results over the comparable results obtained over that of 2014 and in more recent years (see reports & appendices).

It may also be observed upon the tables of results there have been very few spurious (outlying #) results obtained which are elevated but do not show a trend and indeed have returned to that expected, based on previous years experience, during the monitoring period.

Nevertheless as experienced previously, elevated results exist on comparison to the respective groundwater levels, perhaps indicative and possibly support the premise of potential seasonal variation and/or borehole contamination e.g. debris was observed whilst using the water baler. The results of the remaining determinands are below specified limits and these may be observed upon the table of results within the appendices.

7. RECOMMENDATIONS

The results obtained for the year 2015 should again be compared to that compiled for the last few years which are displayed upon the tables of results and as presented within previous annual reports.

These will be further compared for those results to be obtained for 2016 and beyond when these become available and thus any trends identified.

8. CONCLUSION/ASSESSMENT

- No significant concentrations of toxic and/or phytotoxic determinands have been identified within the samples. Results do not exhibit any significant divergence in groundwater quality from that presented within the 2014 and previous reports for those more mobile and soluble determinands.
- The overall leachate concentration does not exhibit any significant divergence from the Completion Criteria as presented within WMP 26A. Notwithstanding this, it is evident that there is some reduction of the concentrations of a significant number of leachate determinands as reported upon/indicated upon the table of results.
- Problems experienced during this monitoring period with Total Organic Carbon will be addressed for the 2016 period due to test laboratory omissions from the testing schedule.
- Under current legislative guidance for the assessment of contaminated sites, e.g. landfill sites, no direct targets/receptors are known to exist within the immediate vicinity of the site.
- As the landfill site has been restored and covered with an engineered cap, of low permeable materials, further water ingress should continue to be significantly reduced and thus the potential for leachate minimised. In addition it may be observed that the leachate rest level has remained constant thus supporting low ingress through the cap.
- From the results presented within the appendices it may be observed that in general the results are indicating an improvement in quality from those obtained in previous reports/years. Notwithstanding this some seasonal variance may still be observed upon the table of results and possibly linked to the groundwater levels when samples are obtained for analysis.
- Any spurious/outlying results highlighted may have also cause elevated results which can skew the overall observation indicating improvement however these will continue to be

monitored as per the monthly/quarterly sampling and testing protocols.

- To continue to compile and compare monitoring results with completion criteria, water quality standards and previous annual monitoring results and to highlight any key variation observed.
- To question results that on reflection do not follow typical trends and to arrange re-testing and/or re-sampling based upon the frequency of the testing schedule.

Summation- On review of the results obtained to date it may be deduced that the site does not exhibit any significant environmental impact upon the water quality in and around the site. Indeed on comparison with the results presented from the late nineties to date, where applicable, water quality has generally remained relatively unchanged although the monitoring performed for 2015 does not immediately indicate an improvement from the 2014 results. Nevertheless monitoring of water quality is to continue as that performed in previous years and again a comparison made to those results obtained for the 2016 monitoring period.

9. REFERENCES

1. Environmental Impact Assessment – Cornelly Quarry – NTS 5440
2. Planning Permission 92/0174
3. Environmental Permit SW/WML 34009 (previously Waste Disposal Licence No.5)
4. Assessment of Groundwater Quality, WRC Report No. CO 2081-m/1 (6/89)
5. Environmental Protection Act 1990
6. Landfill Regulations 2002
7. DOE - Licensing of Waste Management Facilities, WMP 4
8. DOE – Landfill Completion, WMP 26A
9. Groundwater Pollution, EA (1997)
10. EC Directive, EC 75/440/EEC (1975)
11. EC Directive, EC 80/778/EEC (1980)
12. The Water Supply (Water Quality) Regulations 2000 (SI2000 No. 3184) and
    The Water Supply (Water Quality) Regulations 2001 (WSI2001 No. 3911 (W.323))

APPENDICES

Appendix A - Site Location Plan

Appendix B - Site Area Map

Appendix C - Monitoring/Sampling Points

Appendix D - Sampling Point Analytical Results

Appendix E - Example Completion Criteria for Leachates

Appendix F - Standards Used for Assessment of Water Quality

APPENDIX A

SITE LOCATION PLAN

APPENDIX B

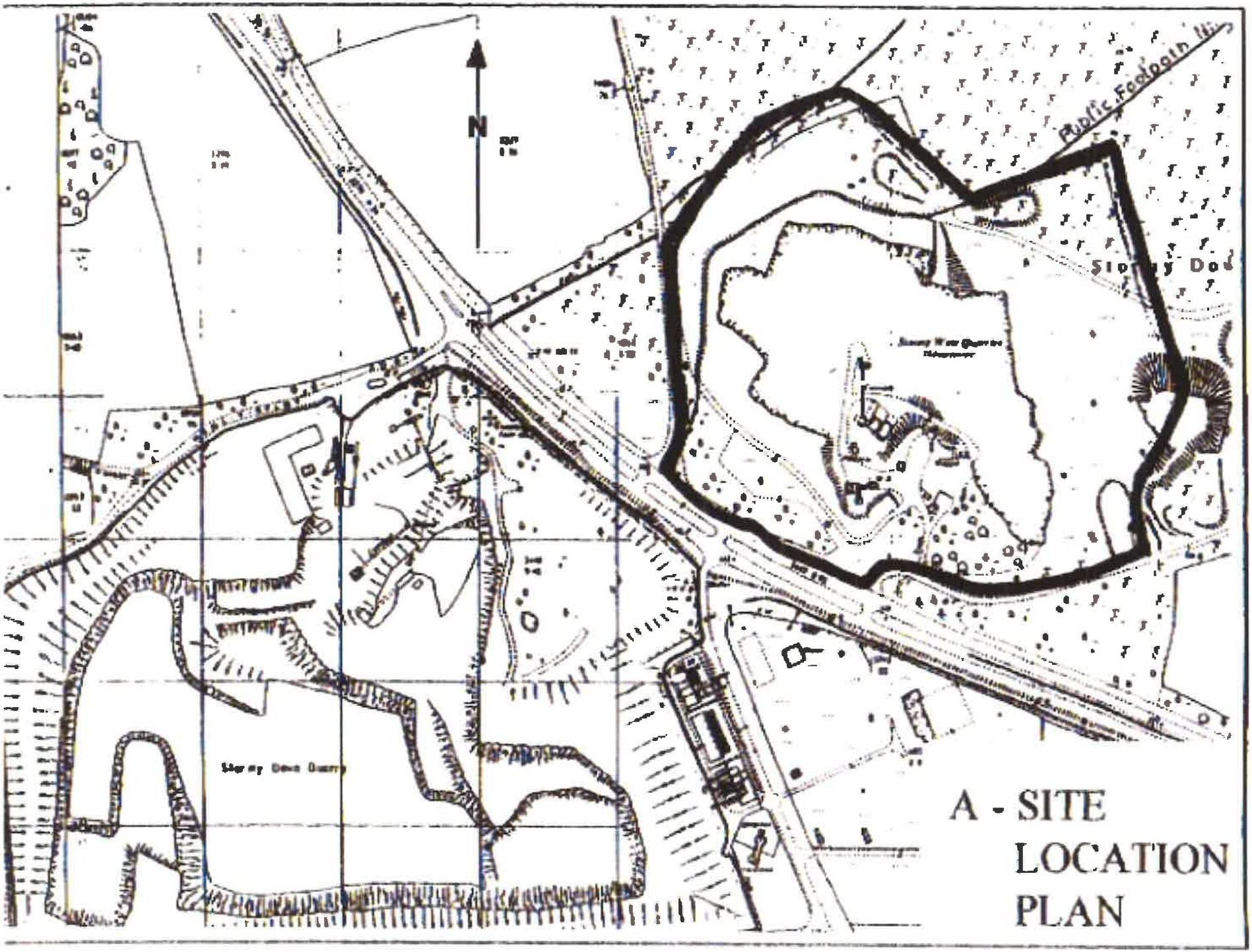
SITE AREA MAP

KEY

KP - indicates location of Kenfig Pool

SP – indicates location of Spring water at Pyle industrial estate

SW – indicates location of the Stormy West landfill site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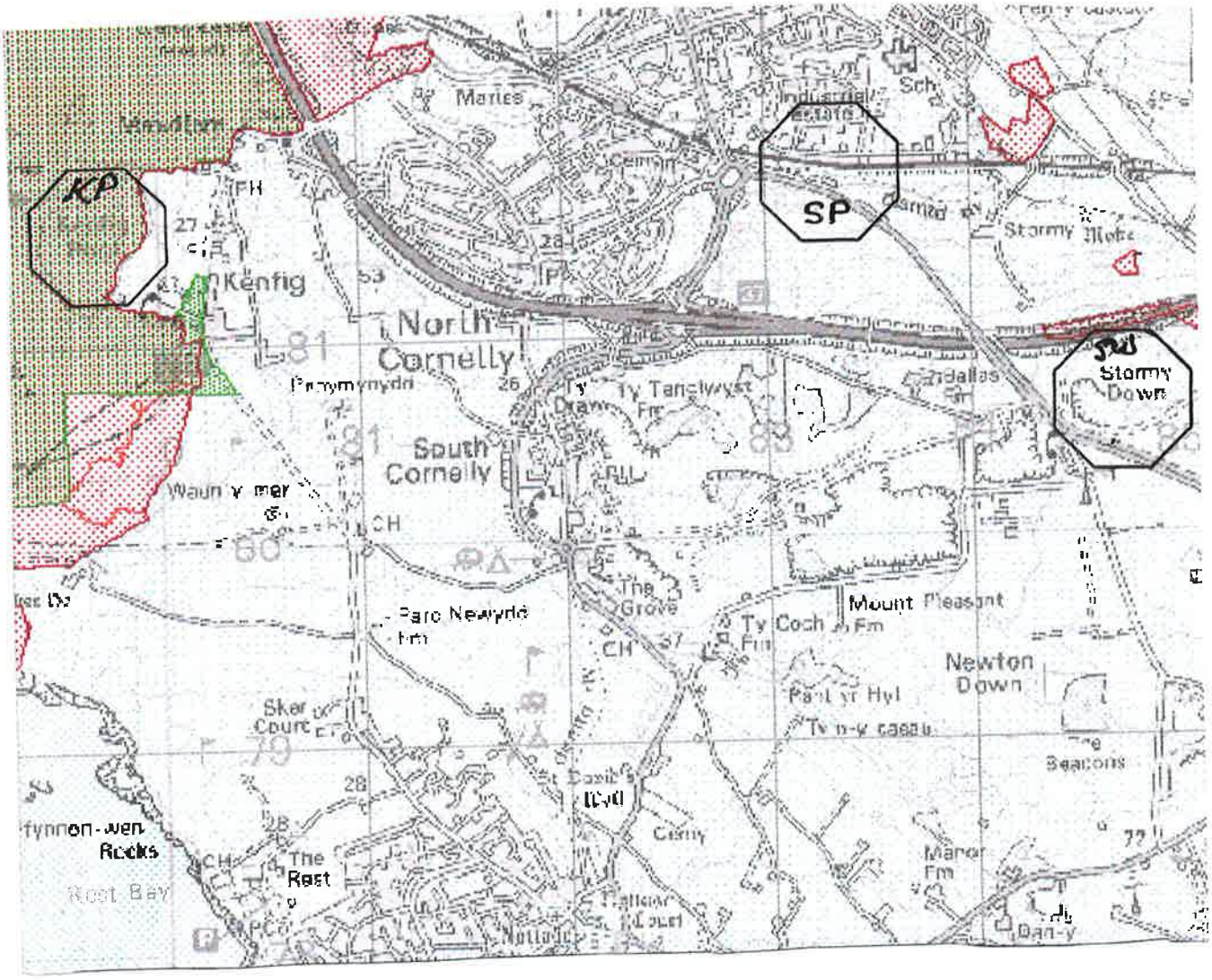
Pacific Footpath
Stanley Dove
Stanley Dove Quarry
A - SITE
LOCATION
PLAN

APPENDIX B

SITE AREA MAP



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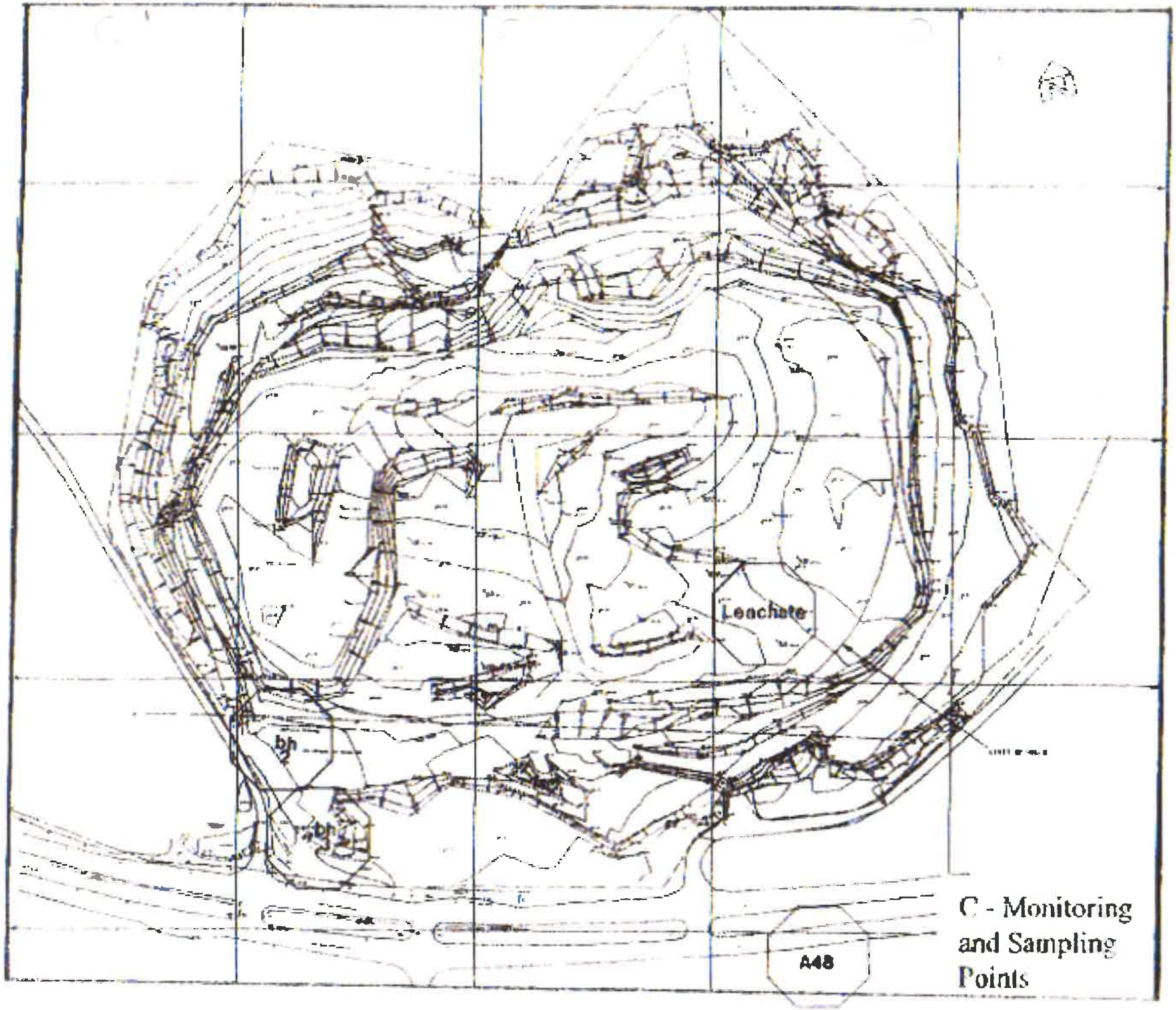
APPENDIX C

MONITORING/SAMPLING POINTS



C - Monitoring and Sampling Points

APPENDIX D

SAMPLING POINT ANALYTICAL RESULTS

Water Analysis 2015 **Stormy West Landfill Site - Stormy Down**

Borehole No. A48

	Sampling Date	WQS	19.03.2015	19.06.2015	15.09.2015	14.12.2015	2015 Mean	2014 Mean	2013 Mean	2012 Mean	2011 Mean
Units	Determinands										
pH Units	pH	**6.5 to 10**	6.8	7.1	6.8	6.8	6.9	7.0	7.3	7.2	7.0
uS/cm	Conductivity @ 20c	**2500**	1109	1642	2210	706	1417	1089	1195	1094	1277
mg/l O	Oxygen (Dissolved)		5.4	3	5	7	5.1	2.1	1.8	2.8	2.7
mg/l	Total Organic Carbon		1.4	nr	nr	nr	0.4	8.5	6.0	3.8	5.0
mg/l O	COD (Total)		<12	65	<10	<10	16.3	17.5	nr	nr	nr
mg/l N	Nitrogen Ammoniacal	**0.5**	<0.1	**47**	**1.3**	<0.1	**12.1**	**9.1**	**17.5**	**3.6**	**12.9**
mg/l N	Total Oxidised Nitrogen		0	<1	0	0	0.0	1.9	4.3	4.0	6.5
mg/l N	Nitrate	**50**	<1	<1	<1	<1	<1	5	4	4.0	6
mg/l N	Nitrite	**0.5**	**<1**	**<1**	**44**	**5.0**	**12.3**	**2.8**	<0.025	<0.025	0.3
mg/l CaCO3	Alkalinity total		408	664	387	380	460	481	471	389	474
mg/l	Chloride	**250**	202	90	112	25	107	86	106	94	126
mg/l O	BOD total+ATU		15	3	<2	<2	4.5	1.8	nr	nr	nr
mg/l	Sulphate	**250**	202	105	80	55	111	102	118	133	132
mg/l	Sodium	**200**	87	79	82	18	67	37	64	43	86
mg/l	Potassium	**12**	4	**35**	10	4	**13**	11	**15**	8	**14**
mg/l	Copper	**2**	0.003	0.001	0.001	0.001	<2	1	<0.009	<0.009	0.006
mg/l	Magnesium	**50**	11	22	13	13	15	13	13	13	15
mg/l	Calcium	**250**	161	164	183	156	166	156	166	179	204
mg/l	Zinc	**5**	0.006	0.003	0.002	<0.0001	0.003	4	<0.018	<0.018	0.02
mg/l	Cadmium	**0.005**	0	0.000	0.000	<0.0007	<0.005	<1	<0.0006	<0.006	0.001
mg/l	Lead	**0.025**	nr	<0.0002	<0.0002	<0.0002	0.000	nr	<0.006	<0.006	0.003
mg/l	Chromium	**0.05**	0.008	0	<0.0002	0.001	0	1	<0.002	<0.002	<0.005
mg/l	Manganese	**0.05**	nr	**1.917**	**0.10**	0.002	**0.50**	nr	**1.31**	**0.18**	**0.74**
mg/l	Iron	**0.2**	0.13	0.03	<0.003	0.1	0.07	**0.7**	**1.4**	<0.2	**0.64**
mg/l	Nickel	**0.02**	nr	0.014	0.002	<0.0005	0.00	nr	0.01	0.01	0.01
mg/l	Volatile fatty acids		nr	<10	<91	<91	<81	<81	<20	<20	<20
mg/l	Phosphate		<1	<1	<1	<1	0.0	0.5	<1.2		0.0
Metres	Depth		12	19	15.2	10.3	14.1	15.4	18.6	12.8	16.1

MEAN Average result based upon actual figures (not using < results)

WQS Water Quality Standard based upon Water Supply (Water Quality) Regulations

Bold results indicates WQS exceeded. nr - no result Depth from exposed pipe to water level - AOD of BH = 100.2

Water Analysis 2015 **Stormy West Landfill Site - Stormy Down**

Borehole No.2 (GW2) - Car park

	Sampling Date	WQS	19.03.2015	19.06.2015	15.09.2015	14.12.2015	2015 Mean	2014 Mean	2013 Mean	2012 mean	2011 Mean
Units	Determinands										
pH Units	pH	**6.5 to10.0**	7.1	7.1	7	7.2	7.1	7.1	7.5	7.3	7.1
uS/cm	Conductivity @ 20c	**2500**	584	795	597	441	604	649	607	546	675
mg/l O	Oxygen (Dissolved)		9	3.4	6	7	6.4	5.8	4.8	4.3	3.1
mg/l	Total Organic Carbon		2	nr	nr	nr	0.5	0.8	2.8	2.5	1.9
mg/l O	COD (Total)		<12	32	12	15	nr	nr	nr	nr	nr
mg/l N	Nitrogen Ammoniacal	**0.5**	<0.1	**4.8**	<0.1	<0.1	**1.2**	0.1	**1.1**	0.10	0.3
mg/l N	Total Oxidised Nitrogen		0.9	<1	0	0	0.2	1.7	1.1	0.9	1.3
mg/l N	Nitrate	**50**	4	9.9	<1	<1	4.0	5.8	1.1	1.0	1.3
mg/l N	Nitrite	**0.5**	**<1**	**<1**	**3**	**<1**	**0.8**	**1.6**	<0.025	<0.025	<0.5
mg/l CaCO3	Alkalinity total		255	357	289	219	280	352	336	273	364
mg/l	Chloride	**250**	31	30	21	23	26	22	18	20	21
mg/l O	BOD total+ATU		16	4	3	<2	5.8	nr	nr	nr	
mg/l	Sulphate	**250**	42	24	22	<10	22	31	20	27	91
mg/l	Sodium	**200**	16	22	15	14	17	13	12	11	11
mg/l	Potassium	**12**	4	8	4	5	5	4	4	3	3
mg/l	Copper	**2**	0.002	0.002	0.004	0.002	<0.009	<0.009	<0.009	<0.009	0.004
mg/l	Magnesium	**50**	8	10	9	7	9	8	8	7	8
mg/l	Calcium	**250**	113	139	117	81	113	111	121	112	150
mg/l	Zinc	**5**	<0.001	0.006	0.005	0.004	0.004	2	<0.018	<0.018	0.013
mg/l	Cadmium	**0.005**	<0.0007	0	<0.00007	<0.00007	<0.00007	<1	<0.0006	<0.0006	<0.005
mg/l	Lead	**0.025**	nr	**<0.2**	0.001	0.001	0.001	nr	<0.006	<0.006	<0.025
mg/l	Chromium	**0.05**	0.008	<0.0002	0.002	0	0.003	**4.25**	<0.002	<0.006	0.003
mg/l	Manganese	**0.05**	nr	**0.157**	0.01	0.002	0.04	nr	**0.06**	0.04	**0.06**
mg/l	Iron	**0.2**	<0.003	<0.003	**0.3**	0.04	0.1	**0.5**	<0.2	<0.2	0.1
mg/l	Nickel	**0.02**	nr	0.002	<0.0005	<0.0005	0.001	nr	<0.02	<0.02	<0.02
mg/l	Volatile fatty acids		<81	<10	<91	<91	<81	<81	<20	<20	<20
mg/l	Phosphate		<1	<1	<1	<1	0.00	0.04	<0.1	<0.1	<0.1
Metres	Depth		12	16.5	11.4	11.3	12.8	15.1	14.7	12.6	14.0

MEAN Average result based upon actual figures (not using < results)

WQS Water Quality Standard based upon Water Supply (Water Quality) Regulations

Bold indicates WQS exceeded nr - no result Depth from exposed pipe to water level - AOD of BH = 101.4

Water Analysis 2015 **Stormy West Landfill Site - Stormy Down**

Borehole No.3 (GW3) - Entrance

	Sampling Date	WQS	19.03.2015	19.06.2015	15.09.2015	14.12.2015	2015 Mean	2014 Mean	2013 Mean	2012 Mean	2011 Mean
Units	Determinands										
pH Units	pH	**6.5 to10.0**	6.8	7	6.8	6.9	6.9	6.7	7.3	7.2	6.9
uS/cm	Conductivity @ 20c	**2500**	849	1023	906	977	939	861	764	850	970
mg/l O	Oxygen (Dissolved)		7	4	8	7	6.5	5.0	2.8	2.6	2.2
mg/l	Total Organic Carbon		1.7	nr	nr	nr	0	5	2	3.0	15
mg/l O	COD (Total)		15	41	<10	<10	14	11.5	nr	nr	nr
mg/l N	Nitrogen Ammoniacal	**0.5**	<0.1	**1.7**	<0.1	<0.1	0.4	**0.6**	**0.8**	0.2	0.5
mg/l N	Total Oxidised Nitrogen		0.8	<1	0.0	0.0	0.2	0.9	1.3	1.3	1.3
mg/l N	Nitrate	**50**	3.7	5	<1	<1	2	4	1.3	1.3	1.3
mg/l N	Nitrite	**0.5**	<1	<1	**6**	**11**	**4.3**	**0.7**	<0.025	<0.025	0.1
mg/l CaCO3	Alkalinity total		412	471	473	351	427	451	407	429	481
mg/l	Chloride	**250**	31	35	24	85	44	30	21	32	36
mg/l O	BOD total+ATU		13	4	<2	<2	<2	<2	nr	nr	nr
mg/l	Sulphate	**250**	65	51	64	121	138	121	120	135	161
mg/l	Sodium	**200**	20	24	21	70	34	31	13	19	22
mg/l	Potassium	**12**	4	7	4	6	5	5	4	4	7
mg/l	Copper	**2**	0.002	1	0.001	0.001	0.3	1	<0.009	<0.009	0.004
mg/l	Magnesium	**50**	12	14	14	12	13	12	10	13	14
mg/l	Calcium	**250**	158	179	193	186	179	155	145	173	208
mg/l	Zinc	**5**	<0.001	0.007	<0.001	0.002	0.002	<5	<0.02	<0.02	0.04
mg/l	Cadmium	**0.005**	0.00	0.001	0.000	<0.0007	<1	<1	<0.0006	<0.0006	0.0003
mg/l	Lead	**0.025**	nr	<0.0002	<0.0002	<0.0002	<0.025	nr	<0.006	<0.006	0.002
mg/l	Chromium	**0.05**	0.007	<0.0002	<0.0002	0.001	<0.05	<1	<0.002	<0.002	0.001
mg/l	Manganese	**0.05**	nr	**0.94**	0.012	0.007	**0.24**	nr	**0.34**	**0.13**	**0.23**
mg/l	Iron	**0.2**	<0.003	0.004	0.02	<0.003	0.01	**0.7**	**0.3**	**0.30**	**0.3**
mg/l	Nickel	**0.02**	nr	0.006	<0.0005	<0.0005	0.002	nr	0.003	0.00	0.004
mg/l	Volatile fatty acids		<81	<10	<91	<91	<81	<81	<20	<20	<20
mg/l	Phosphate		<1	<1	<1	<1	<0.05	<0.05	<1.2	<1.2	<0.1
Metres	Depth		12.4	19	13	10.3	13.7	18.8	17.4	13.0	15.5

MEAN Average result based upon actual figures (not using < results)

WQS Water Quality Standard based upon Water Supply (Water Quality) Regulations

Bold indicates WQS exceeded nr - no result Depth from exposed pipe to water level - AOD of BH = 100.6

Water Analysis 2015 **Stormy West Landfill Site - Stormy Down**

Surface Water - Kenfig Pool

	Sampling Date	WQS	19.03.2015	19.06.2015	15.09.2015	14.12.2015	Mean 2015	Mean 2014	Mean 2013	Mean 2012	Mean 2011
Units	Determinands										
pH Units	pH	5.5 to 9 g		8		7.6	7.8	8.3	8.1	7.2	8.9
uS/cm	Conductivity @ 20c	1000 g		330		231	281	172	204	219	213
mg/l O	Oxygen (Dissolved)			7		7	7	8	9	8	9
mg/l	Total Organic Carbon			nr		nr	nr	5.7	nr		0
mg/l O	COD (Total)	30 g		24		10	17	8	20	23	26
mg/l N	Nitrogen Ammoniacal	4		<0.1		<0.1	<0.1	0.1	<0.27	<0.27	0.17
mg/l N	Total Oxidised Nitrogen			<1		0	<1	0.03	nr		0
mg/l N	Nitrate			<1		<1	<1	<0.3	<0.4	<0.4	0.4
mg/l N	Nitrite			<1		<1	<1	<0.05	<0.025	<0.025	0.008
mg/l CaCO3	Alkalinity total			74		80	77	84	77	83	68
mg/l	Chloride	200 g		34		33	34	34	27	27	33
mg/l O	BOD total+ATU			<2		<2	<2	<2	nr		0
mg/l	Sulphate	250		<10		<10	<10	10	3	3	0
mg/l	Sodium			20		22	21	17	14	14	16
mg/l	Potassium			1		0.9	1.0	1.0	0.7	0.7	0.5
mg/l	Copper	1 g		<0.0004		<0.0004	<0.0004	<1	nr		0
mg/l	Magnesium			4		5	5	3	4	4	4
mg/l	Calcium			26		28	27	24	25	28	26
mg/l	Zinc	5		<0.0001		<0.001	<0.001	3	nr	0	0
mg/l	Cadmium	0.005		<0.00007		<0.00007	<0.00007	<1	nr	0	0
mg/l	Lead	0.05		<0.0002		<0.0002	<0.0002	nr	nr		0
mg/l	Chromium	0.05		<0.0002		<0.0002	<0.0002	**4.33**	nr		0
mg/l	Manganese	1 g		0.001		<0.001	<0.001	nr	0.02	0.06	0.03
mg/l	Iron	2		<3		<3	<3	0.03	<0.23	<0.23	0.2
mg/l	Nickel			<0.0005		<0.0005	<0.0005	nr	nr	0	0
mg/l	Volatile fatty acids			<10		<91	<91	<81	<20	<20	<20
mg/l	Phosphate			<1		<1	<1	<0.05	<1.2	<1.2	<1.2

MEAN Average result based upon actual figures (not using < results)

WQS EC Directive (75/440/EEC, g-guide)

Bold results indicates WQS exceeded

nr no result

na not applicable

Water Analysis 2015

Surface Water - Pyle

Stormy West Landfill Site - Stormy Down

	Sampling Date	WQS	19.03.2015	19.06.2015	15.09.2015	14.12.2015	Mean 2015	Mean 2014	Mean 2013	Mean 2012	Mean 2011
Units	Determinands										
pH Units	pH	5.5 to 9 g	7.7	7.8	7.6	7.6	7.7	7.8	8.3	7.8	8.2
uS/cm	Conductivity @ 20c	1000 g	540	563	459	478	510	530	488	395	499
mg/l O	Oxygen (Dissolved)		9	6	6	7	7	9	4.8	9	6
mg/l	Total Organic Carbon		2	nr	nr	nr	nr	nr	nr	0	0
mg/l O	COD (Total)	30 g	<12	16	20	<10	9	15	7	**59**	8
mg/l N	Nitrogen Ammoniacal	4	1	0.2	0.1	0.5	0.45	<0.27	<0.27	<0.27	<0.19
mg/l N	Total Oxidised Nitrogen		4	<1	0	0	1	nr	nr	0	0
mg/l N	Nitrate		17	9	<1	<1	6.5	10.3	2.2	1.9	2.0
mg/l N	Nitrite		<1	<1	6	11	4.250	5.375	0.04	0.019	0.015
mg/l CaCO3	Alkalinity total		229	208	203	223	216	261	241	198	237
mg/l	Chloride	200 g	30	26	20	28	26	28	24	22	30
mg/l O	BOD total+ATU		7	<2	6	<2	3.25	0	nr	0	0
mg/l	Sulphate	250	20	15	15	14	16	21	16	11	11
mg/l	Sodium		18	16	16	18	17	204	12	11	14
mg/l	Potassium		3	3	5	6	4	3	4	4	3
mg/l	Copper	1 g	0.002	0.001	0.004	0.001	0.002	0.3	nr	0	0
mg/l	Magnesium		11	9	7	10	9	10	9	8	10
mg/l	Calcium		90	77	78	88	83	82	89	73	100
mg/l	Zinc	5	0.01	0.006	0.003	0.003	0	1	nr		0
mg/l	Cadmium	0.005	<0.00007	<0.00007	<0.00007	<0.00007	0	0	nr		0
mg/l	Lead	0.05	nr	<0.0002	0	<0.0002	0	0	nr		0
mg/l	Chromium	0.05	0.006	<0.0002	<0.0002	<0.0002	0.0015	**3.5**	nr		0
mg/l	Manganese	1 g	nr	<0.0004	0.003	0.032	nr	nr	0.13	0.12	0.03
mg/l	Iron	2	0.007	<3	0.3	0.08	0.1	0.5	0.8	0.1	<0.19
mg/l	Nickel		nr	<0.0005	0.001	<0.0005	nr	nr	nr		0
mg/l	Volatile fatty acids		<81	<1	<91	<91	<20	<20	<20	<20	<20
mg/l	Phosphate		<1	0.2	<1	<1	<1.2	<1.2	<1.2	<1.2	<0.08

MEAN Average result based upon actual figures (not using < results)

WQS EC Directive (75/440/EEC, g-guide)

Bold results indicates STD exceeded

nr no result

Water Analysis 2015 **Stormy West Landfill Site - Stormy Down**

Leachate

	Sampling Date	L/F Comp.	27.01.15	17.02.15	19.03.15	21.04.15	26.05.15	19.06.15	15.07.15	18.08.15	15.09.15	13.10.15	20.11.15	14.12.15	Mean 15	Mean 14	Mean 13	Mean 12	Mean 11	Mean 10
Units	Determinands																			
pH Units	pH	6.5 - 8.5	7.1	7.5	7.2	7.5	7.5	7.7	7.4	7.4	7.2	7.3	6.7	7.2	7.3	7.2	7.4	7.5	7.5	7.4
uS/cm	Conductivity @ 20c	4000	**5400**	**6660**	**6380**	**8350**	**9060**	**8870**	**8680**	**9100**	**5100**	**8500**	3670	**4370**	**7012**	**6967**	**7243**	**6200**	**5993**	**5993**
mg/l O	Oxygen (Dissolved)	.			5			8			5			6	2					
mg/l O	BOD total+ATU	.			32			15			6			<2	13	8	44	16	41	43
mg/l O	COD (Total)	.			537			795			472			424	557	777	751	686	869	1082
mg/l CaCO3	Alkalinity total	.			2737			3567			2408			210	2231	3516	2650	2068	2658	3019
mg/l N	Ammonia as N	5			**281**			**473**			**290**			**221**	**316**	**510**	**415**	**362**	**408**	**479**
mg/l N	Total Oxidised Nitrogen	.			0			<1			0			0	0	0.1	0.2	8.1	0.1	0.0
mg/l	Chloride	2000			586			814			450			399	562	717	536	400	494	589
mg/l	Sulphate	2500			586			<10			<10			<10	146.5	8.0	9.3	<5	<5	<5
mg/l	Total Organic Carbon	10			**181**			**nr**			**nr**			**nr**	**45**	**237**	**107**	**78**	**131**	**187**
mg/l	Cadmium	0.05			<0.00007			<0.0007			<0.0007			<0.0007	0.000	<1	<0.0006		0.0013	0.0010
mg/l	Chromium	0.5			0.014			0.011			0.005			0	0.01	**19**	0.01	0.01	0.02	0.03
mg/l	Lead	0.5			nr			0.001			0.00			0.00	0.00	nr	0.04	<0.006	0.1	0.1
mg/l	Copper	1			0.001			<0.0004			<0.0004			0.001	0.001	2	<0.009	<0.009	0.02	0.03
mg/l	Nickel	0.5			nr			0.034			0.02			0.02	0.02	nr	0.03	0.02	0.0	0.0
mg/l	Zinc	1			0.003			0.008			<0.001			0.005	0.004	**21**	0.02	0.02	0.1	0.2
mg/l	Iron	2			1			**1.698**			1.872			0.5	1	1	**5.3**	**2.3**	**5.5**	**7.3**
mg/l	Manganese	0.5			nr			0.2			0.1			0.1	0.1	nr	**1.4**	0.2	0.2	0.3
mg/l	Sodium	1500			595			959			516			509	645	422	512	410	423	527
mg/l	Potassium	120			**189**			**292**			**150**			**139**	**193**	**221**	**185**	**143**	**170**	**196**
mg/l	Calcium	1000			98			112			135			124	117	97	121	116	131	129
mg/l	Magnesium	500			68			85			54			55	66	68	48	48	47	48
mg/l	Volatile fatty acids				<81			<10			<91			<91	0.0	<81	<20	<20	<20	<20
mg/l	Phosphate				<1			<1			<1			<1	0.0	3.7	1.7	1.5	2.2	2.4
Metres	Depth		14.4	14.5	14.4	14.7	14.5	14.8	14.9	15	15	15	15	14.7	14.7	14.5	14.8	14.8	15.1	15.2

MEAN Average result based on actual figures (not less than <) .

L/F Comp. Landfill Completion criteria (as WMP26A).

Results in bold indicate result exceeds standard.

BH - B5 taken as leachate sample/depth nr - no result Depth from exposed pipe to water level - AOD of BH = 108

APPENDIX E

EXAMPLE COMPLETION CRITERIA FOR LEACHATES